A

Surname ______________________

Other Names ______________________

Centre Number ______________________

Candidate Number ______________________

Candidate Signature ______________________

I declare this is my own work.

GCSE
COMBINED SCIENCE: TRILOGY
Foundation Tier

F

Physics Paper 1F
8464/P/1F

Time allowed: 1 hour 15 minutes

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

JUN218464P1F01

For this paper you must have:
- **a ruler**
- **a scientific calculator**
- **the Physics Equations Sheet (enclosed).**

INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Pencil should only be used for drawing.**
- **Answer ALL questions in the spaces provided.**
- **If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).**
- **Do all rough work in this book. Cross through any work you do not want to be marked.**

- In all calculations, show clearly how you work out your answer.

INFORMATION

- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

DO NOT TURN OVER UNTIL TOLD TO DO SO

0 1

A student investigated the density of different types of rock.

FIGURE 1 shows a piece of limestone.

FIGURE 1

0 1 . 1

The student was NOT able to calculate the volume of the piece of limestone using measurements taken with a ruler.

What is the reason? [1 mark]

Tick (✓) ONE box.

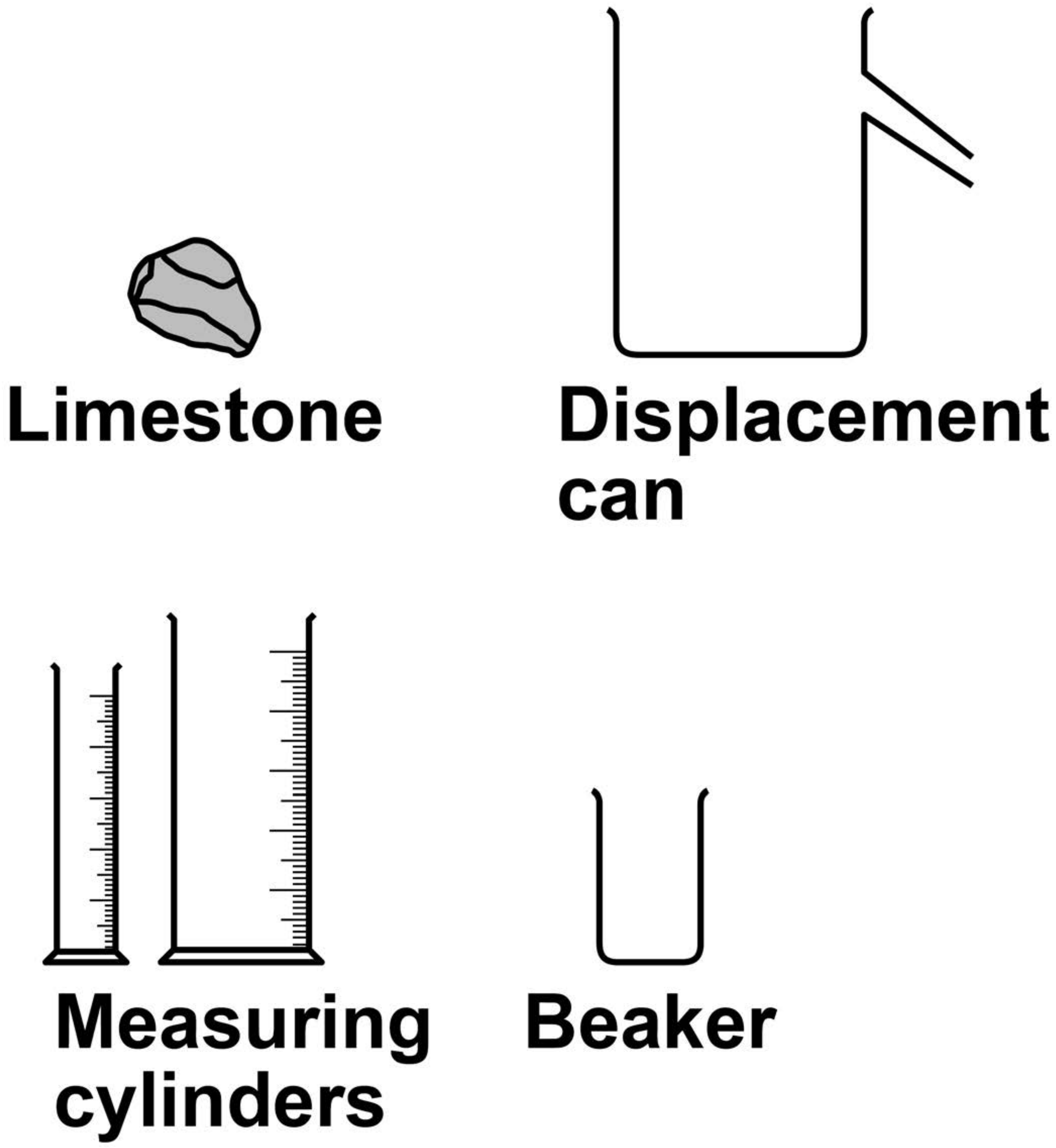
- [ ] **A ruler is not very accurate.**
- [ ] **The piece of limestone has an irregular shape.**
- [ ] **There is a large uncertainty when using a ruler.**

[Turn over]

01.2

FIGURE 2 shows some of the equipment given to the student.

FIGURE 2



Describe a method the student could use to determine the volume of the piece of limestone. [4 marks]

[Turn over]

01.3

The mass of the piece of limestone was 155 g.

The volume of the piece of limestone was 62 cm^3.

Calculate the density of the piece of limestone.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

[2 marks]

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Density = ____________________ g/cm^3

0 1 . 4

Density can be measured in g/cm^3.

What is another unit for density? [1 mark]

Tick (✓) ONE box.

☐ cm/g^3

☐ kg/m^3

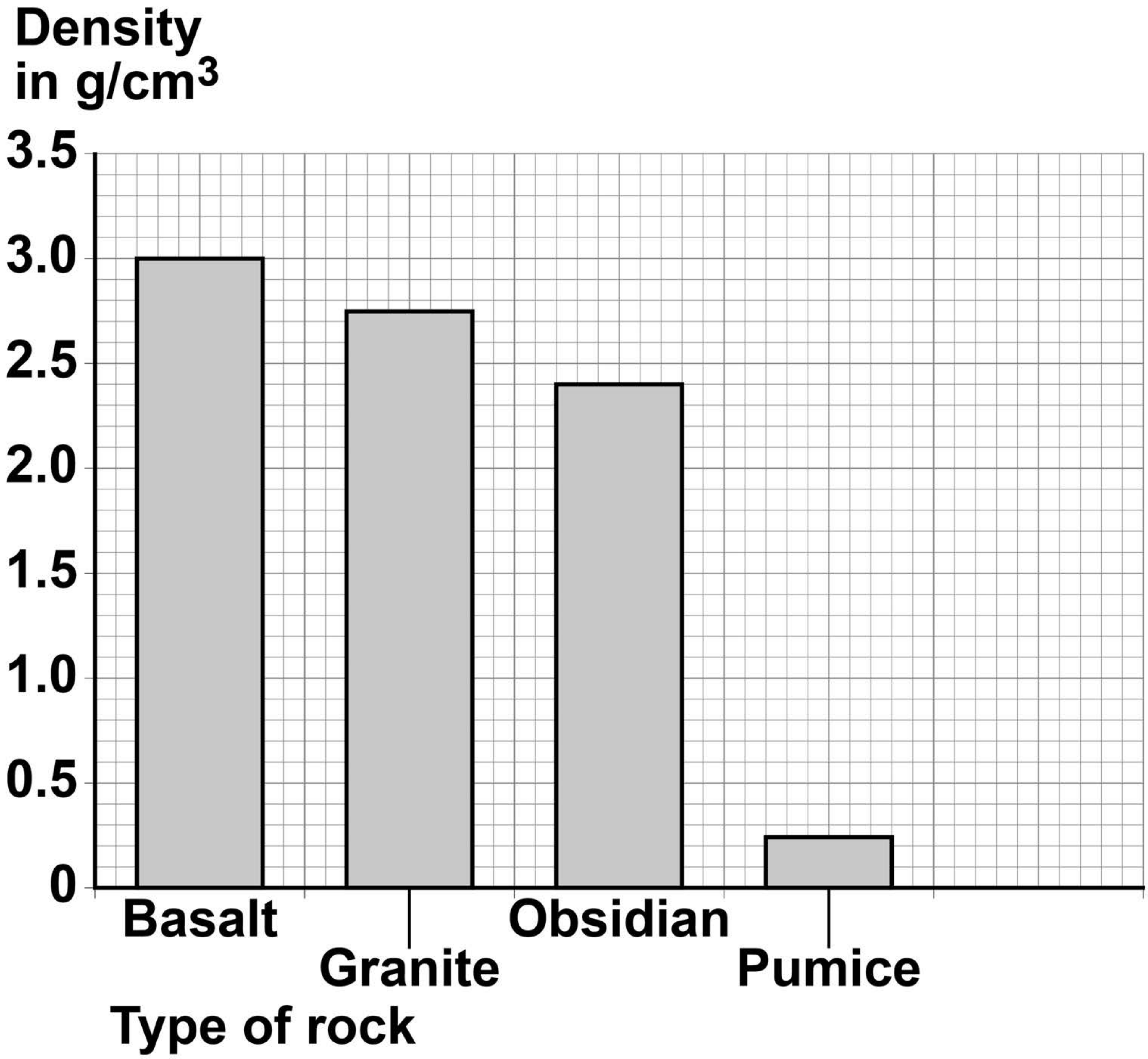
☐ kg^3/m

☐ kg^3/cm

[Turn over]

FIGURE 3 gives the density of some other types of rock.

FIGURE 3



The student has a sample of an unknown type of rock.

The density of this rock is 2.4 g/cm^3.

0 1 . 5

Draw a bar on FIGURE 3, on the opposite page, to show the density of the unknown type of rock. [1 mark]

[Turn over]

0 1 . 6

Complete the sentence.

Choose the answer from the list. [1 mark]

- **basalt**
- **granite**
- **obsidian**
- **pumice**

The data in FIGURE 3 suggests that the unknown type of rock is

__________________________.

0 1 . 7

The student CANNOT be certain that the unknown type of rock is one of the types of rock in FIGURE 3, on page 10.

Give a reason why. [1 mark]

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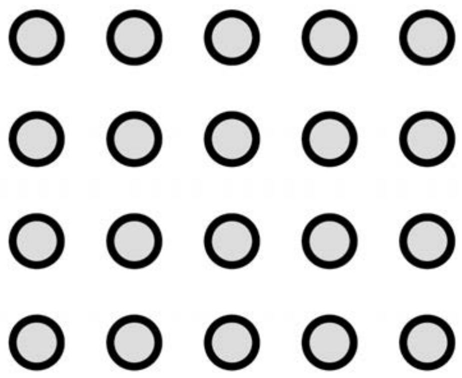
[Turn over]

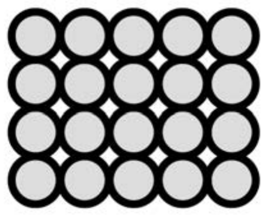
Pumice is a type of rock that has holes in it. The holes contain air.

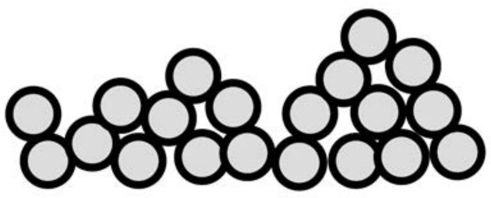
0 1 . 8

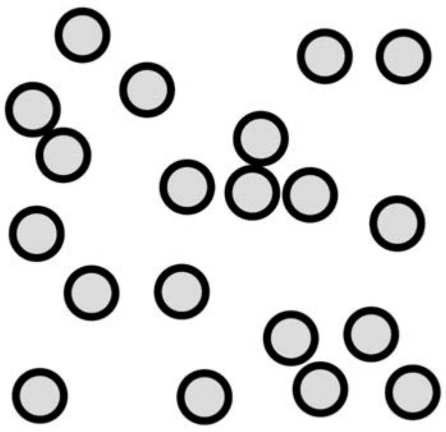
Which diagram, on the opposite page, shows the arrangement of particles in air?
[1 mark]

Tick (✓) ONE box.

☐ 

☐ 

☐ 

☐ 

[Turn over]

0 1 . 9

Complete the sentence.

Choose the answer from the list. [1 mark]

- **less than**
- **the same as**
- **more than**

The holes containing air cause the density of pumice to be ________________ the density of other types of rock.

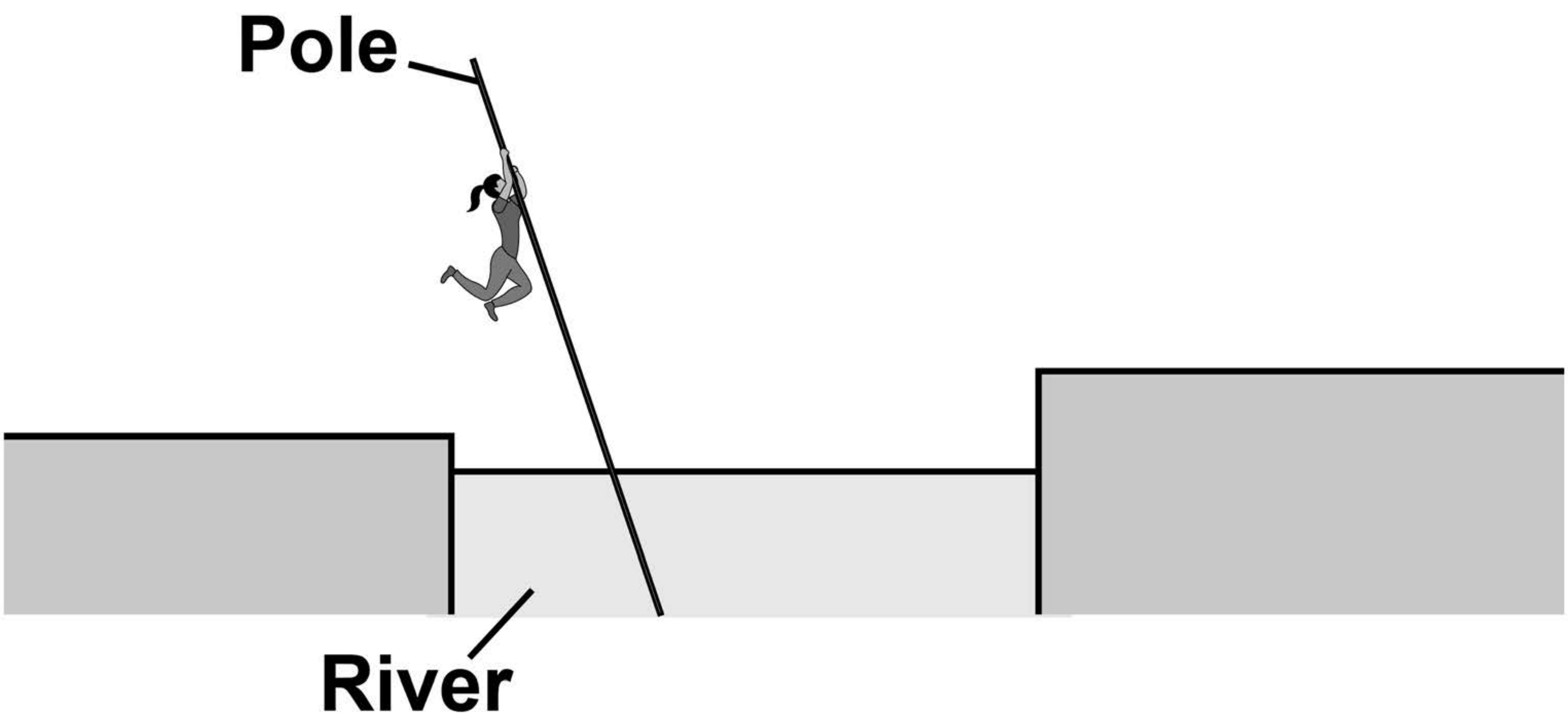
13

0 2

In a sport called far-leaping, an athlete uses a long pole to cross a river.

FIGURE 4 shows an athlete far-leaping.

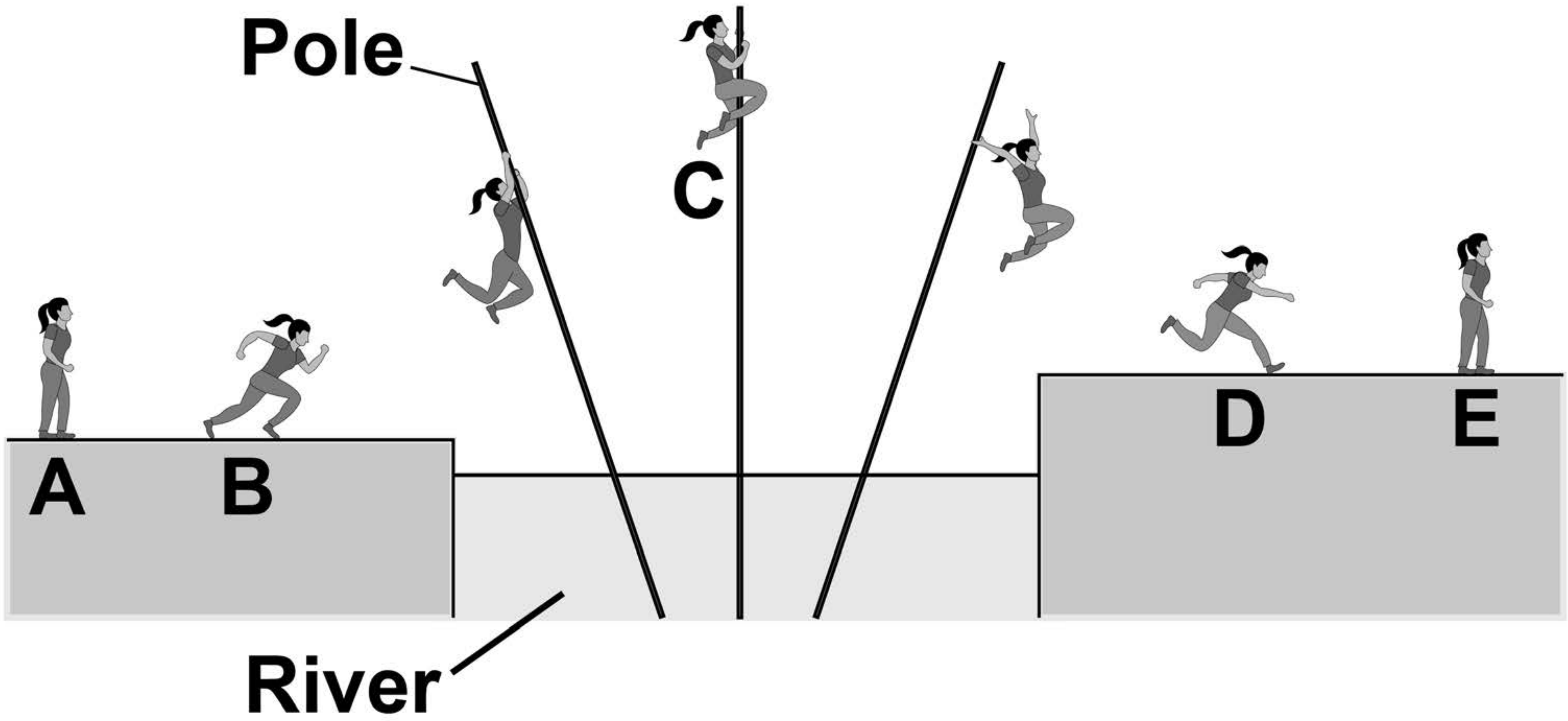
FIGURE 4



[Turn over]

FIGURE 5 shows the athlete in different stages of far-leaping.

FIGURE 5



0 2 . 1

Complete the sentence.

Choose answers from the list. [2 marks]

- **chemical**
- **nuclear**
- **kinetic**
- **elastic potential**
- **gravitational potential**

Between positions A and B the athlete speeds up. There is an increase in the athlete's ____________________ energy and a decrease in the athlete's ____________________ store of energy.

[Turn over]

0 2 . 2

Between positions B and C the athlete jumps to the pole and climbs up it.

Which statement describes a change in the athlete's energy between positions B and C? [1 mark]

Tick (✓) ONE box.

☐ **Elastic potential energy decreases.**

☐ **Elastic potential energy increases.**

☐ **Gravitational potential energy decreases.**

☐ **Gravitational potential energy increases.**

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[Turn over]

0 2 . 3

The pole falls over from position C. The athlete lets go of the pole and lands at position D.

The change in height of the athlete between positions C and D is 3.0 m.

mass of athlete = 50 kg

gravitational field strength = 9.8 N/kg

Calculate the change in gravitational potential energy of the athlete between positions C and D.

Use the equation:

change in gravitational potential energy = mass × gravitational field strength × change in height

[2 marks]

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Change in gravitational potential energy = ____________ J

[Turn over]

0 2 . 4

The kinetic energy of the athlete at position D is 1600 J.

mass of athlete = 50 kg

Calculate the speed of the athlete at position D.

Use the equation:

$$\text{speed} = \sqrt{\frac{2 \times \text{kinetic energy}}{\text{mass}}}$$

Choose the unit from the list. [3 marks]

- **m/s**
- **J/kg**
- **J/s**

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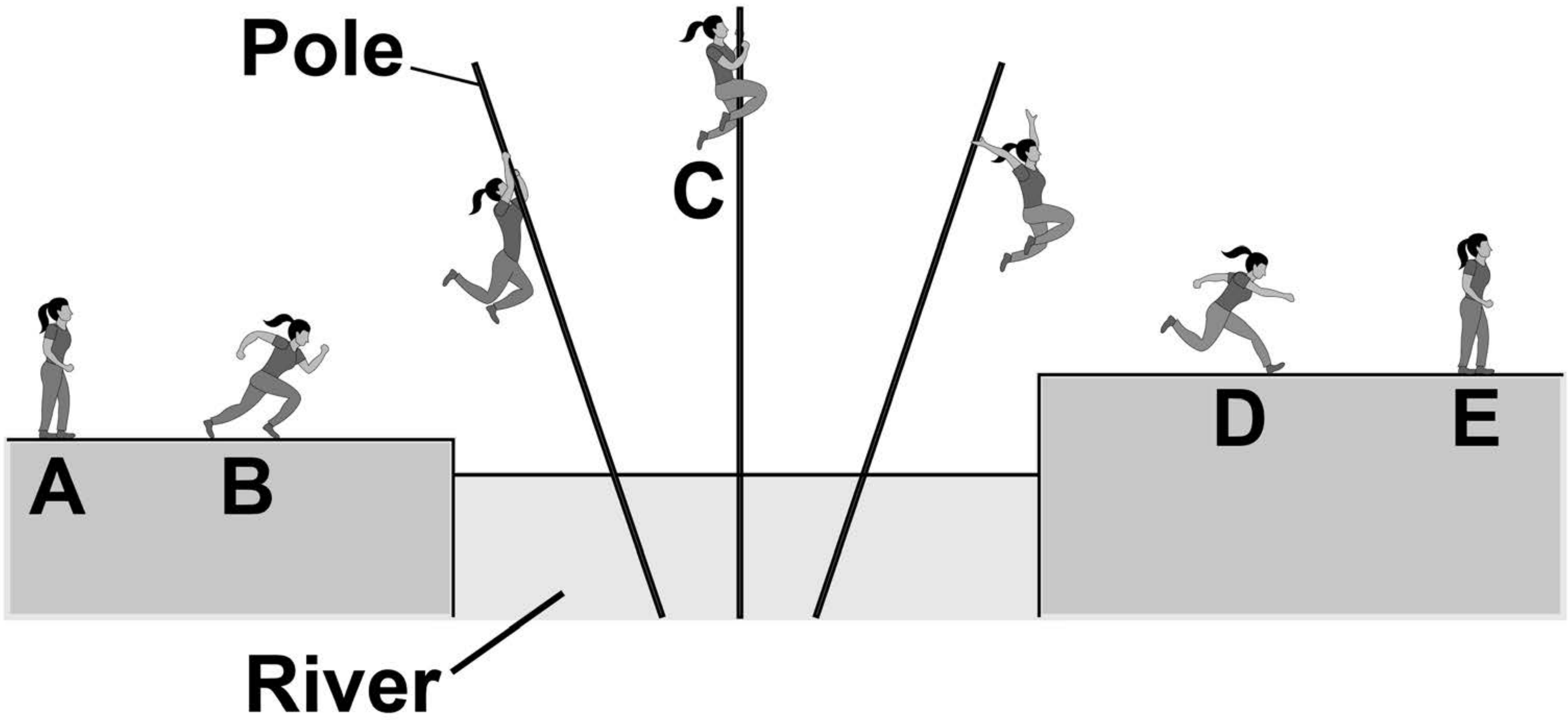
Speed = ____________ **Unit** ______________

[Turn over]

FIGURE 5 is repeated below.

FIGURE 5



0 2 . 5

At positions A and E, the athlete is standing still.

Why does the athlete have less energy in position E than in position A? [1 mark]

Tick (✓) ONE box.

- ☐ **Energy has been transferred from the athlete to the air.**
- ☐ **The air temperature has decreased.**
- ☐ **The height of the athlete above the water has increased.**

[Turn over]

0 2 . 6

Athletes have a large power output when they are far-leaping.

What is meant by the power of an athlete? [1 mark]

Tick (✓) ONE box.

- [ ] **The rate at which the athlete transfers energy.**
- [ ] **The size of the maximum force exerted by the athlete.**
- [ ] **The total energy transferred by the athlete.**

BLANK PAGE

[Turn over]

0 2 . 7

A second athlete crossed the same river by far-leaping.

The second athlete had less power than the first athlete when running between position A and position B.

Complete the sentences on the opposite page.

Choose answers from the list.

Each answer may be used once, more than once or not at all. [2 marks]

- **less than**
- **the same as**
- **more than**

Two factors that could explain why the second athlete had less power than the first athlete are:

1. The time taken by the second athlete to run between position A and position B was ____________________ the first athlete.

2. The work done by the second athlete was ____________________ the first athlete.

12

[Turn over]

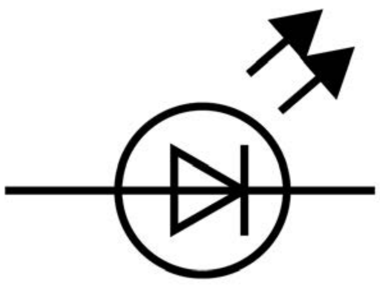
0 3

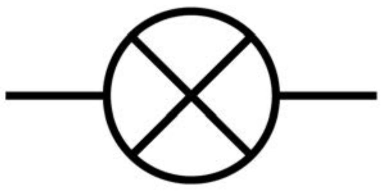
A filament lamp breaks if the electric current in the filament becomes too big.

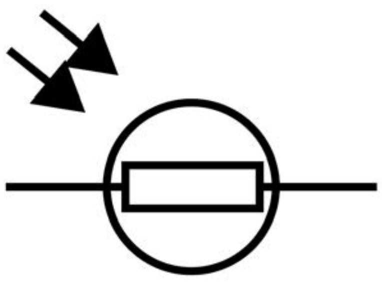
0 3 . 1

What is the correct symbol for a filament lamp? [1 mark]

Tick (✓) ONE box.

☐ 

☐ 

☐ 

0 3 . 2

What is meant by an electric current?
[1 mark]

Tick (✓) ONE box.

- [ ] The energy carried by each unit of charge
- [ ] The flow of electrical charge
- [ ] The number of electrons in a circuit
- [ ] The speed at which charge moves

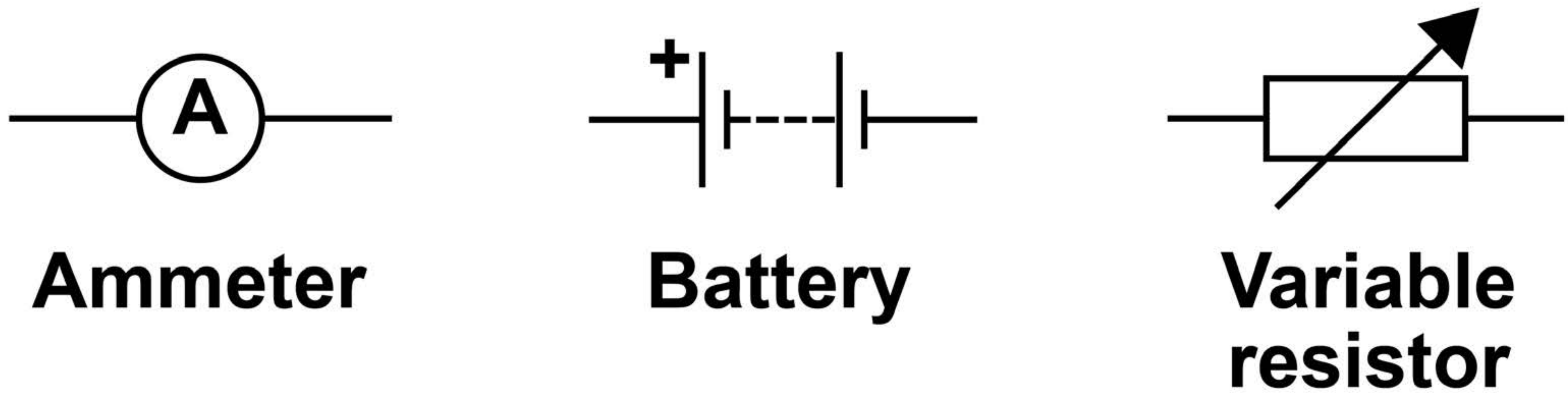
[Turn over]

A manufacturer investigated the maximum current value of some filament lamps.

0 3 . 3

FIGURE 6 shows the symbols for an ammeter, a battery and a variable resistor.

FIGURE 6



The manufacturer connected an ammeter, battery, filament lamp and variable resistor in series.

Draw a circuit diagram to show the manufacturer's circuit.

Include the symbol for a filament lamp from Question 03.1, on page 32. [1 mark]

0 3 . 4

How could the manufacturer increase the current in the filament lamp? [1 mark]

Tick (✓) ONE box.

- [ ] **Add an extra ammeter to the circuit.**
- [ ] **Decrease the resistance of the variable resistor.**
- [ ] **Use a battery with a smaller potential difference.**

0 3 . 5

When the potential difference across a filament lamp was 0.75 V, the current in the filament lamp was 0.16 A.

Calculate the power of the filament lamp.

Use the equation:

power = potential difference × current
[2 marks]

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____

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Power = ____________________ W

[Turn over]

0 3 . 6

Write down the equation which links charge flow (Q), current (I) and time (t).
[1 mark]

____

0 3 . 7

The manufacturer increased the current in the filament lamp to 200 mA.

Calculate the charge flow through the filament lamp in 15 s. [3 marks]

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Charge flow = ______________________ C

0 3 . 8

The manufacturer increased the current in the filament lamp from 200 mA.

The filament in the lamp broke when the current reached 320 mA.

How many times greater than 200 mA was the current at which the filament broke?
[1 mark]

____

____

____

______________________________ **times greater**

[Turn over]

0 3 . 9

The manufacturer tested lots of filament lamps.

The current at which the filament lamps broke was 320 ± 60 mA.

What is the range of currents at which the filament lamps broke? [1 mark]

Tick (✓) ONE box.

☐ **60 mA to 320 mA**

☐ **260 mA to 320 mA**

☐ **320 mA to 380 mA**

☐ **260 mA to 380 mA**

12

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[Turn over]

0 4

Solar intensity is a measure of the radiation received from the Sun at the surface of the Earth.

FIGURE 7, on the opposite page, shows how the mean solar intensity changes with the distance from the equator.

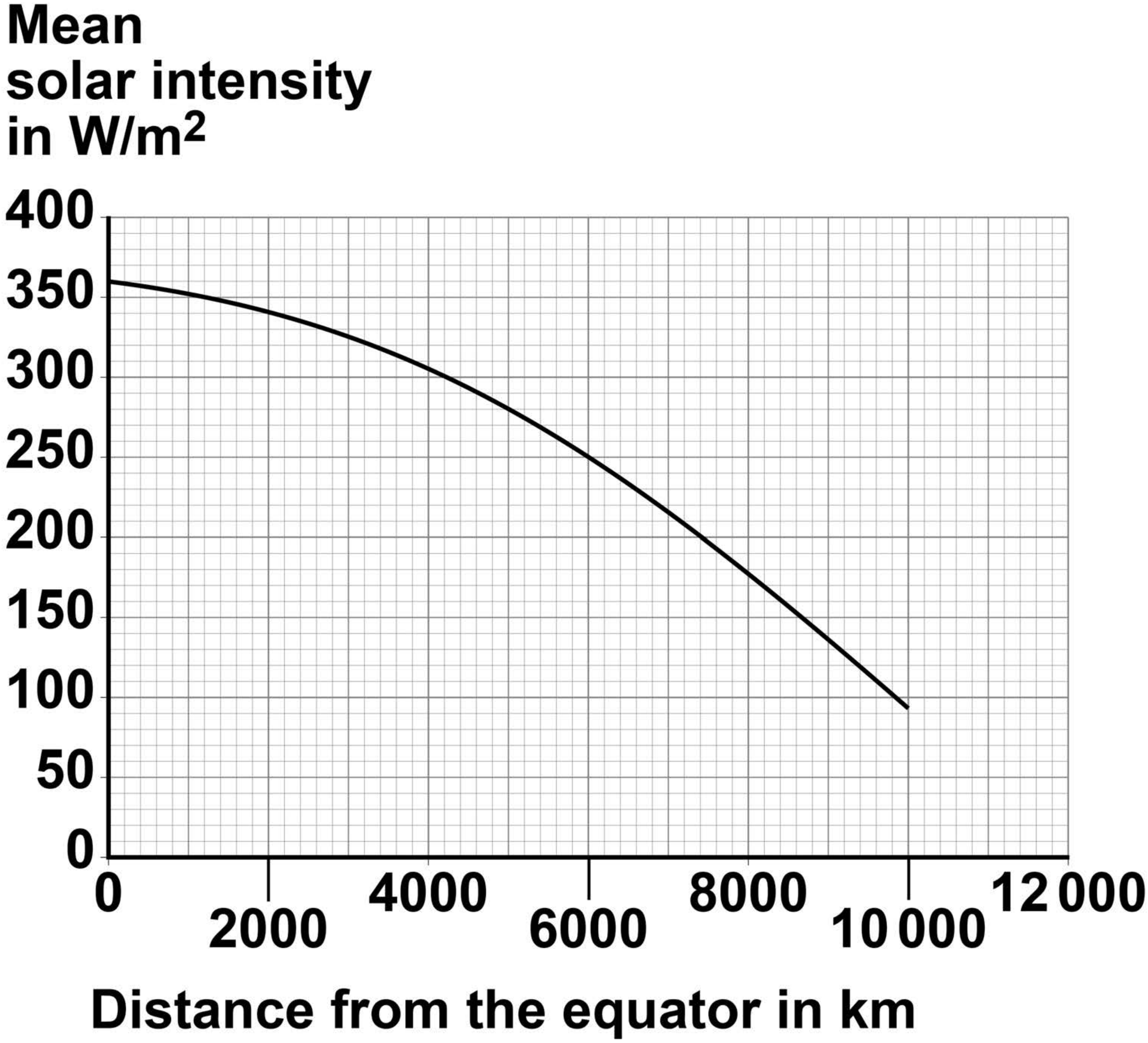
0 4 . 1

The city of Athens is 4200 km from the equator.

What is the mean solar intensity in Athens? [1 mark]

Mean solar intensity = ____________ W/m^2

FIGURE 7

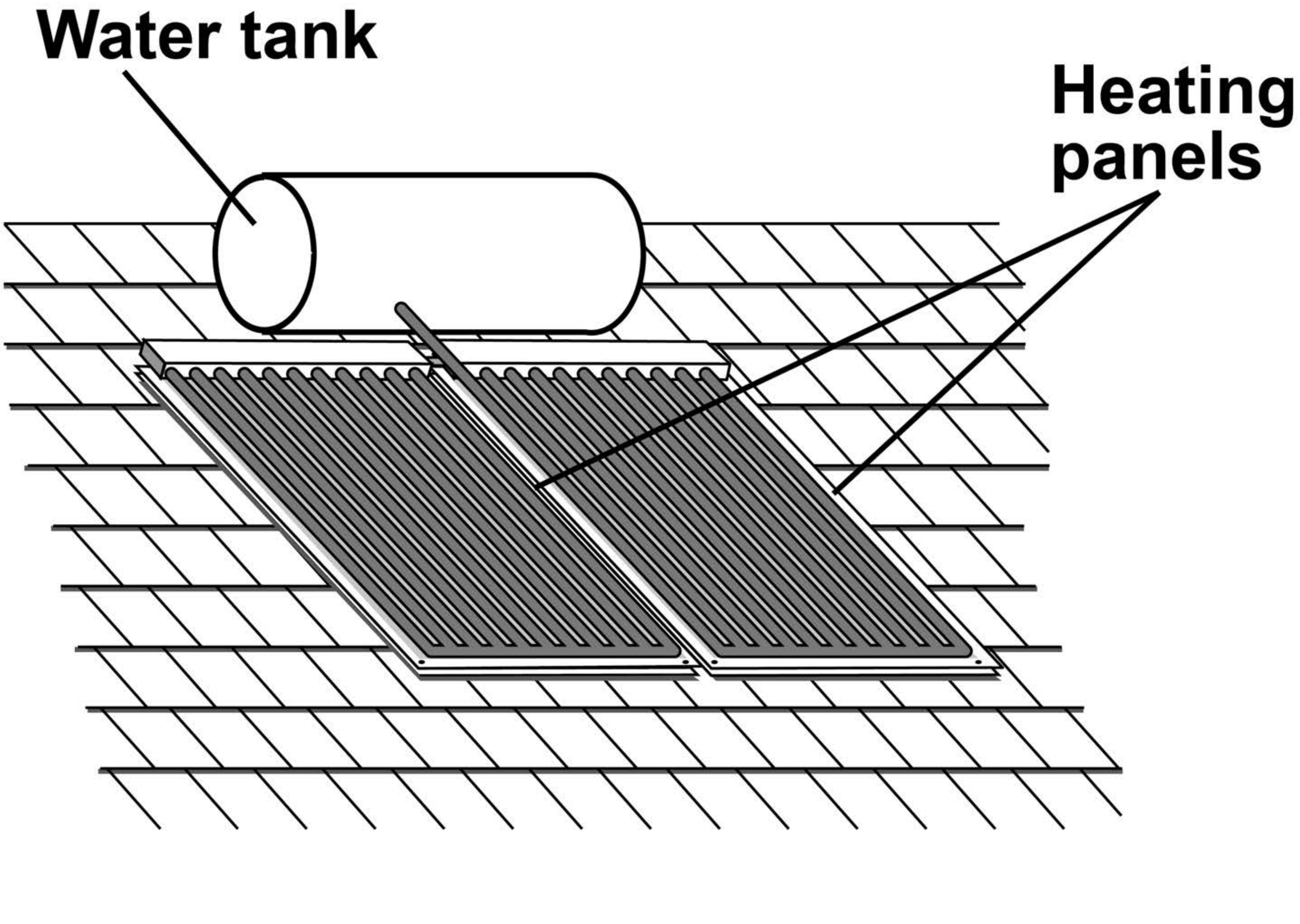

Mean
solar intensity
in W/m2
400
350
300
250
200
150
100
50
0
0
2000
4000
6000
8000
10 000
12 000
Distance from the equator in km

Solar water heaters use radiation from the Sun to heat water.

The heated water is stored in a water tank.

FIGURE 8 shows a solar water heater on the roof of a building.

FIGURE 8



0 4 . 2

Cities closer to the equator have many more buildings with solar water heaters than cities further away from the equator.

Suggest why. [1 mark]

[Turn over]

0 4 . 3

The use of solar water heaters may reduce the need to burn fossil fuels.

Complete the sentence.

Choose the answer from the list. [1 mark]

- **carbon dioxide**
- **nitrogen**
- **oxygen**

Burning fossil fuels contributes to global warming because there is an increase in the amount of ______________________ in the atmosphere.

0 4 . 4

The efficiency of the solar water heater is 0.61

Calculate the useful power output when the total power input to the solar water heater is 1100 W.

Use the equation:

useful power output =

efficiency × total power input

[2 marks]

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Useful power output = ________________ W

[Turn over]

0 4 . 5

Different solar water heaters have different sized heating panels.

Suggest how the size of the heating panels affects the input power to a solar water heater. [1 mark]

0 4 . 6

Water has a high specific heat capacity.

What is meant by the specific heat capacity of water? [1 mark]

Tick (✓) ONE box.

☐ **The energy required to change the state of 1 kg of water from liquid to gas.**

☐ **The energy required to increase the temperature of 1 kg of water by 1 °C.**

☐ **The power required to change the state of 1 kg of water from liquid to gas.**

☐ **The power required to increase the temperature of 1 kg of water by 1 °C.**

[Turn over]

0 4 . 7

The water tank contained 80 kg of water.

The change in thermal energy of the water was 8 400 000 J.

specific heat capacity of water = 4200 J/kg °C

Calculate the temperature change of the water.

Use the Physics Equations Sheet.
[3 marks]

Temperature change = ________________ °C

[Turn over]

0 4 . 8

The water tank is thermally insulated.

How does thermal insulation affect the rate of energy transfer from the water in the tank? [1 mark]

Tick (✓) ONE box.

☐ **Thermal insulation decreases the rate of energy transfer.**

☐ **Thermal insulation does not change the rate of energy transfer.**

☐ **Thermal insulation increases the rate of energy transfer.**

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[Turn over]

0 4 . 9

TABLE 1 shows information about different materials.

TABLE 1

Material	Thermal conductivity in arbitrary units
A	3
B	2
C	8
D	4

Which material in TABLE 1 is the best thermal insulator? [1 mark]

Tick (✓) ONE box.

☐ **A**

☐ **B**

☐ **C**

☐ **D**

[Turn over]

12

0 5

FIGURE 9 shows a mobile phone with its battery removed.

FIGURE 9

A student measured the potential difference across the battery and then put the battery into the phone.

0 5 . 1

What is the equation linking current (I), potential difference (V) and resistance (R)? [1 mark]

Tick (✓) ONE box.

- [ ] $I = V R$
- [ ] $R = I V$
- [ ] $V = I R$
- [ ] $V = I^2 R$

[Turn over]

0 5 . 2

The current in the electronic circuit in the mobile phone was 0.12 A.

The potential difference across the battery was 3.9 V.

Calculate the resistance of the electronic circuit in the mobile phone. [3 marks]

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Resistance = ______________________________ Ω

0 5 . 3

Write down the equation which links energy (*E*), power (*P*) and time (*t*).
[1 mark]

[Turn over]

0 5 . 4

The battery was fully charged when it was put into the mobile phone.

The battery discharged when the mobile phone was switched on.

The average power output of the battery as it discharged was 0.46 watts.

The time taken to fully discharge the battery was 2500 minutes.

Calculate the energy transferred by the battery. [3 marks]

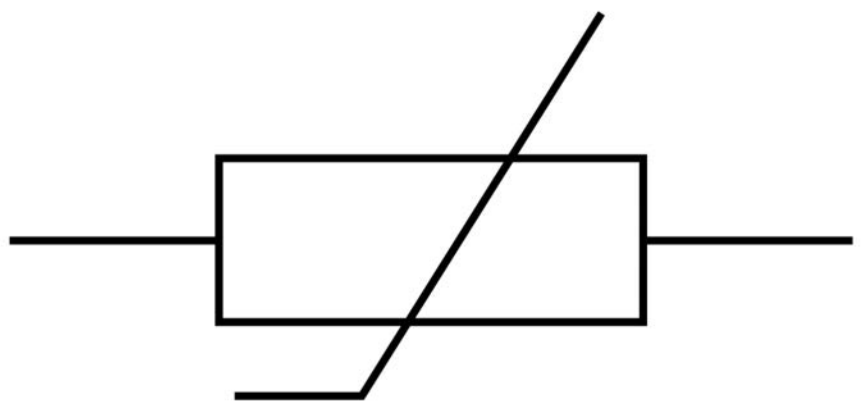
Energy transferred = ____________________ J

[Turn over]

The mobile phone includes a sensor to monitor the temperature of the battery.

FIGURE 10 shows the circuit symbol for a component used in the sensor.

FIGURE 10



0 5 . 5

What component does the circuit symbol shown in FIGURE 10 represent? [1 mark]

0 5 . 6

The temperature of the component in FIGURE 10 increases.

The potential difference across the component remains constant.

Explain what happens to the current in the component. [2 marks]

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11

06

A radioactive source emits alpha, beta and gamma radiation.

06.1

An alpha particle is the same as a helium nucleus.

How many times bigger is the radius of a helium atom than the radius of an alpha particle? [1 mark]

Tick (✓) ONE box.

- [ ] Less than 100 times bigger
- [ ] Exactly 5000 times bigger
- [ ] More than 10 000 times bigger

06.2

Alpha particles can ionise atoms in the air.

What happens to an atom when it is ionised by an alpha particle? [2 marks]

Tick (✓) TWO boxes.

☐ **A neutron in the atom becomes a proton.**

☐ **The atom becomes a positive ion.**

☐ **The atom gains a neutron.**

☐ **The atom gains a proton.**

☐ **The atom loses an electron.**

[Turn over]

0 6 . 3

A spark detector is a device that can be used to detect alpha radiation.

A spark detector works by alpha particles ionising atoms in the air near a wire mesh.

A large potential difference creates a spark when the air near the wire mesh is ionised.

Suggest why a spark detector CANNOT detect beta radiation. [1 mark]

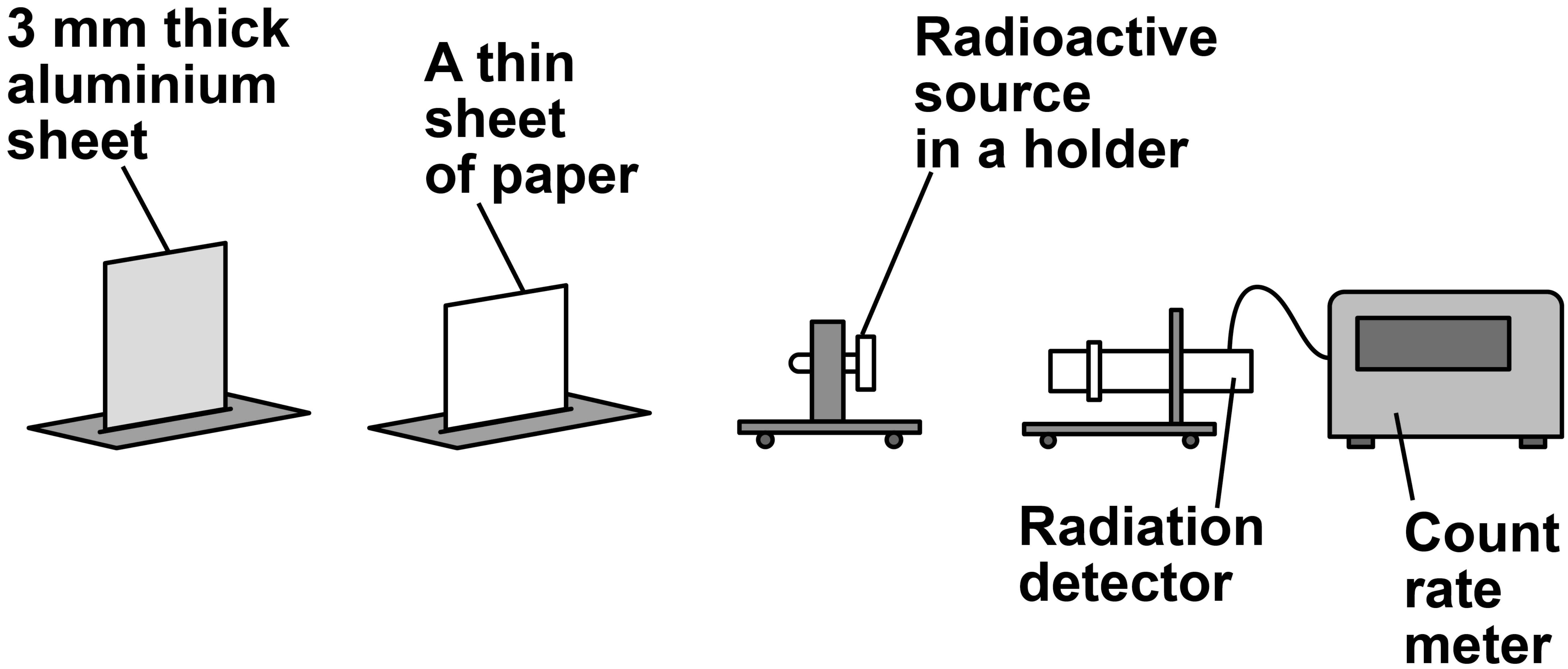
0 6 . 4

A teacher wants to demonstrate that the radioactive source emits alpha, beta and gamma radiation.

FIGURE 11, on page 68, shows the equipment the teacher has.

[Turn over]

FIGURE 11


3 mm thick aluminium sheet
A thin sheet of paper
Radioactive source in a holder
Radiation detector
Count rate meter

Describe a method the teacher could use. [6 marks]

[Turn over]

10

END OF QUESTIONS

Additional page, if required.
Write the question numbers in the left-hand margin.

Additional page, if required.

Write the question numbers in the left-hand margin.

Additional page, if required.

Write the question numbers in the left-hand margin.

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For Examiner's Use	
Question	Mark
1	
2	
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TOTAL	

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2 1 6 G 8 4 6 4 / P / 1 F